If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match.
The on-screen version of the Collider-Accelerator Department Procedure is the Official Version.
Hard copies of all signed, official, C-A Operating Procedures are kept on file in the C-A ESHQ Training Office, Bldg. 911A.

C-A OPERATIONS PROCEDURES MANUAL

7.1.11 25 kW Helium Refrigerator Cooldown

Text Pages 2 through 9

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

Approved: _____***Signature on File***_____ _____
Collider-Accelerator Department Chairman Date

S. Sakry

7.1.11 25 kW Helium Refrigerator Cooldown

1. Purpose

This procedure provides instructions for the cooldown of the RHIC 25 kW Helium Refrigerator in two phases from room temperature (~300°K) to 4°K. Phase 1 involves cooling the warm end of the refrigerator down to a temperature of 60°K. Phase 2 involves bringing the temperature down to 4°K and setting the refrigerator cold end on the calorimeter.

2. Responsibilities

2.1 The Shift Supervisor, or an Operator designated by the Shift Supervisor, is responsible for conducting the procedure and providing documentation in the Cryogenic Control Room Log and in the Cryogenic Valve Log.

2.2 Should a problem arise during the completion of this procedure, the Shift Supervisor shall contact the Technical Supervisor for instructions before continuing.

3. Prerequisites

3.1 The performance of the refrigerator relies heavily on the system being free of contaminants. Prior to cooldown, the cryogenic system shall be pumped, purged, and scrubbed. For instructions on scrubbing the refrigerator, please reference C-A OPM 7.1.13. The main compressor system shall be lined up and ready for operation.

3.2 The Operator shall be trained by the Shift Supervisor.

3.3 Operator shall be familiar with the following drawings:

Drawing 3A995009 25 KW Helium Refrigerator P & ID
Drawing 3A995066 6:00 Yellow Ring P & ID (used with C-A-OPM-ATT 7.1.11.a)
Drawing 3A995086 6:00 Blue Ring P & ID (used with C-A-OPM-ATT 7.1.11.a)
Refrigerator Valve Reference Guide

3.4 Operator shall be familiar with the physical location of components on the drawings listed under 3.3.

3.5 Operator shall be familiar with the control pages found on the CRISP control system.

4. Precautions

4.1 Confirm the availability of Particle Accelerator Safety System (PASS) in the refrigeration wing of 1005R.

4.2 All personnel entering the refrigeration wing of 1005R must have a personal ODH monitor and carry an emergency escape pack, if the refrigerator is operating.

4.3 This procedure assumes that cooldown of the refrigerator will use HX1A/2A, adsorber bed A, and all "A" string turbines. If HX1B/2B, adsorber bed B, or "B" string turbines are used, valve selection must be adjusted accordingly.

5. Procedure

_____ 5.1 Align compressor building valves.

_____ 5.2 Align the hygrometer and oxygen monitor in compressor building to sample compressor discharge.

_____ 5.3 Verify valve positions as specified in C-A-OPM-ATT 7.1.11.a.

_____ 5.4 Phase 1

_____ 5.4.1 Set the following process valves to the CLOSED position:

H9A	H328A
H33A	H352A
H86A	H385A
H100A	H402A

_____ 5.4.2 Set the following process valves to the OPEN position:

H38A	H156M
H90M	H410M
H123A	H398M*
H130M	H798M*
H131A	H406M*

*The indicated position of these values must be manually updated on CRISP page D51.

_____ 5.4.3 Start main compressors as needed.

_____ 5.4.4 Select a warm turbine inlet filter and purge per C-A-OPM 7.1.50 "Purge of Warm Expander Inlet Filter".

_____ 5.4.5 Initialization warm turbines 1A, 2A, 3A, and 4A per C-A-OPM 7.1.40 "Warm Turbines "A" Train Initialization".

_____ 5.4.6 Ensure warm turbine mid pressure is less than 7 atm.

_____ 5.4.7 Set turbine vanes as follows:

H330A - Closed
H339A - 15% Open
H354A-25% Open
H357A - 25% Open

_____ 5.4.8 Place turbine outlet valve H380A in automatic with a setpoint of 1.40 atm.

_____ 5.4.9 Start warm turbines.

_____ 5.4.10 When #4 turbine outlet temperature at TI361H is less than or equal to 150° K, control helium flow through the cooldown return line so as to maintain a pressure at PT17H (H9A outlet) between 2 - 3 atmospheres by throttling valve H9A.

_____ 5.4.11 In manual mode, put valve H153A at 100% open and open valve H344A 100%.

Caution:
Throughout this procedure, monitor temperature sensor TI3063 on the low pressure return to the compressors. Should TI3063 drop below 270°K, quickly evaluate the bypass configuration.

_____ 5.4.12 Monitor the temperature of the cooldown return flow at TI8H (H9A inlet). When TI8H reads below 150°K open valve H425M.

_____ 5.4.13 Close valve H827M.

_____ 5.4.14 Monitor the temperature of the cooldown return flow at TI8H (H9A inlet). When TI8H reads ~ 120°K, close valve H156M and slowly open valve H376M.

_____ 5.4.15 Close valve H425M.

_____ 5.4.16 When the outlet temperature of the on-line adsorber is below 90°K, enable the adsorber logic alarm.

_____ 5.4.17 Monitor the temperature of the cooldown return flow at TI8H (H9A inlet). When TI8H reads ~ 60°K and the adsorber outlet temperature is less than or equal to 80°K, you are ready to go to Phase 2.

_____ 5.4.18 Set H3025A (recovery pump back) in automatic at 1.18 atmospheres. Set the emergency tank fill valve H2918A in automatic control.

_____ 5.4.19 Set valves H153A and H344A in automatic mode.

_____ 5.5 Phase 2

_____ 5.5.1 Set the following valves to the CLOSED position:

H9A	H376M
H130M	H413M
H131A	H813M

_____ 5.5.2 Open valve H827M.

_____ 5.5.3 Control helium flow through the cooldown return line so as to maintain a return pressure at PT129H (inlet of intermediate pot) of 7 to 12 atmospheres by adjusting valve H86A. Maintain turbine #4 and adsorber bed at their normal temperature

_____ 5.5.4 Select a cold turbine inlet filter and purge per C-A-OPM 7.1.51, "Purge of Cold Expander Inlet Filter".

_____ 5.5.5 Initialize cold turbines 5A and 6A per C-A-OPM 7.1.42, "Cold Turbines "A" Train Initialization".

_____ 5.5.6 Monitor the temperatures of HX5/6. When the outlet temperatures of heat exchanger 5/6 reaches 150°K as read on temperature sensor TI30H, continue.

_____ 5.5.7 Align path to return by closing valve H410M and opening valve H409M.

_____ 5.5.8 Start turbines 5A/6A and monitor temperature sensor TI 408H (#6 outlet temperature).

_____ 5.5.9 Verify control circuit has placed valve H159A (HX7) in Auto Control. Auto Control is enabled by valve H406M being open and turbine train running.

_____ 5.5.10 When temperature sensor TI408 (#6 outlet temperature) is less than TI31H (HX7M H.P. outlet), crack open valve H410M. (While waiting for the temperature to drop, go to step 11 and come

back to steps 9 and 10 when TI408H is less than TI31H).

_____ 5.5.11 Slowly continue to open valve H410M and start to close valve H409M. This step is complete when valve H410M is fully open with valve H409M completely closed.

_____ 5.5.12 Open the following valves:

H33A	H130M
H58A	

_____ 5.5.13 Close valve H38A.

_____ 5.5.14 Set valve H95A in automatic at 2.5 ATM.

_____ 5.5.15 In manual, open valve H100A slightly to maintain less than or equal to 2 atmospheres of pressure in the pots.

_____ 5.5.16 Set the following valves to the OPEN position:

H5M	H123A
H26A	H4643A
H238M	

_____ 5.5.17 In manual mode, set valve H54A to 50%.

_____ 5.5.18 Monitor temperature sensor TT228H and TI233H. (TT228H is located before valves H123A and H130M, and TI233H is located between valves H40A and H69A.) When TT228H and TI233H reach 180°K, open valve H425M slowly. This step will take some time due to the low flow rate

_____ 5.5.19 Close valve H827M.

_____ 5.5.20 Continue to monitor temperature sensors TI228H and TI233H. When TI228H and TI233H reach 50°K open valve H157M.

_____ 5.5.21 Close valve H425M.

_____ 5.5.22 When TI228H and TI233H are less than TI408H, open valve H409M and close valve H157M.

_____ 5.5.23 Open valve H437A and start cold vacuum pump #1. Set bypass valve H40A in automatic mode.

_____ 5.5.24 Set valves H54A and H58A in automatic mode.

_____ 5.5.25 Close valve H131A.

_____ 5.5.26 Monitor temperature sensors TI45H (outlet of cold vacuum pumps) and TI228H (return line before valves H123A and H130M).

_____ 5.5.27 Close valve H26A.

_____ 5.5.28 In manual mode, set valve H86A to flow 200 g/sec as read on flow element FE35H.

_____ 5.5.29 Adjust valve H100A to raise the helium pot pressure to less than or equal to 2 atmospheres.

_____ 5.5.30 Monitor temperature sensors TI45H (outlet of cold vacuum pumps) and TI228H (return line before valves H123A and H130M). When TI45H and TI228H average 5.5°K or less, open valve H38A. NOTE: Watch temperature sensor TI219H (on the return side of HX8/18/9) closely. If TI219H approaches 12°K close valve H38A, wait 5 minutes and reopen valve H38A. Repeat this cycle until opening valve H38A is successful.

_____ 5.5.31 Close valves:

H409M
H123A

_____ 5.5.32 Place hi, intermediate and low pot level control valves (H100A, H106A and H114A) in automatic control at 75%. Control rate of pot fill by adjusting maximum open limit of valve H100A.

_____ 5.5.33 Maintain flow on FE35H at 200 g/sec by adjusting valve H86A in manual mode.

_____ 5.5.34 When the intermediate and low pots holds 75 % liquid, apply heat to the calorimeter (CRISP page D41) so as to maintain balance. Adjust valve H86A and the calorimeter as needed.

6. Documentation

6.1 The check-off lines on the procedure are for place-keeping only. The procedure is not to be initialed or signed, it is not a record.

6.2 The Shift Supervisor shall document the completion of the procedure in the Cryogenics Control Room Log

7. References

7.1 Drawing 3A995009, 25°kW Helium Refrigerator P&ID.

7.2 Drawing 3A995066, 6:00 Yellow Ring P&ID.

7.3 Drawing 3A995086, 6:00 Blue Ring P&ID.

7.4 Refrigerator Valve Reference Guide.

7.5 C-A-OPM 7.1.40, "Warm Turbines "A" Train Initialization".

7.6 C-A-OPM 7.1.50, "Purge of Warm Expander Inlet Filter".

7.7 C-A-OPM 7.1.51, "Purge of Cold Expander Inlet Filter".

7.8 C-A-OPM 7.1.42, "Cold Turbines "A" Train Initialization".

8. Attachments

8.1 C-A-OPM-ATT 7.1.11.a " Valve Position Tables".